Calibration of Satellite Antenna Arrays using Signals of Opportunity

Completed Technology Project (2012 - 2016)

Project Introduction

Beamforming arrays offer important advantages for NASAs remote sensing applications, including the ability to perform beamforming, scanning, and nulling. Due to increasing science needs and growing levels of terrestrial Radio Frequency Interference, or RFI, the spatial nulling capability is appealing and even necessary for future Earth observation missions. However, placing deep nulls in specific directions requires precise knowledge of the arrays radiation pattern, and this is not easily obtained. Current calibration techniques have difficulty accounting for antenna element interactions and platform scattering, and thus the ideal solution would be for a satellite to automatically measure its own antenna array response as it performs its normal operations. Moreover, the satellite should not use calibration signals, but rather make use of the RFI sources themselves as signals of opportunity for calibration. I have previously studied the problem of angle of arrival estimation using a poorly calibrated antenna response. From my experience in this area, I see the opportunity to extend current approaches to enable calibration. Through a combination of subspace algorithms, fusing of diverse measurements, and blind signal separation algorithms, the required array responses and associated angles of arrival should be obtainable, even from low Earth orbit. Online and in-situ array calibration, if proven applicable, will be a powerful enabler for higher sensitivity remote measurements. Moreover, beamforming arrays are becoming as common as wifi, the required processing power is available in packages as small as our phones, and thus the developed techniques could benefit many cutting edge systems, large and small, common and specific.

Anticipated Benefits

Online and in-situ array calibration, if proven applicable, will be a powerful enabler for higher sensitivity remote measurements. Moreover, beamforming arrays are becoming as common as wifi, the required processing power is available in packages as small as our phones, and thus the developed techniques could benefit many cutting edge systems, large and small, common and specific.

Project Image Calibration of Satellite Antenna Arrays using Signals of Opportunity

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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Responsible Program:

Space Technology Research Grants

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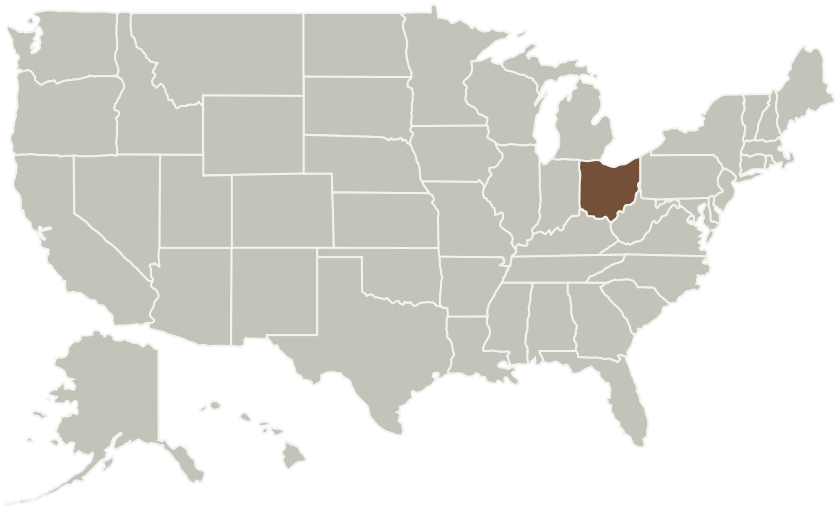
Primary U.S. Work Locations and Key Partners



Primary U.S. Work Locations
Ohio

Images

11515-1363116049100.jpg
Project Image Calibration of Satellite Antenna Arrays using Signals of Opportunity
(https://techport.nasa.gov/image/1723)

Project Management

Program Director:
Claudia M Meyer

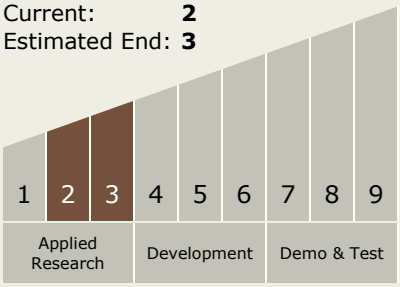
Program Manager:
Hung D Nguyen

Principal Investigator:
Inder Gupta

Co-Investigator:
Andrew Kintz

Technology Maturity (TRL)

Start: **2**
Current: **2**
Estimated End: **3**



Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.1 Remote Sensing Instruments/Sensors
    - TX08.1.1 Detectors and Focal Planes

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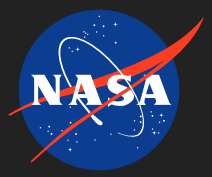

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Project Website:

https://www.nasa.gov/directorates/spacetech/home/index.html